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# THE ADVANCE OF BIOLOGY IN 1896.

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THE appearance of the second volume of *L'Année Biologique*,[1] with its valuable summaries of progress in general biology, gives the opportunity for a second summary of progress like that published in the *Naturalist* last year.

*Cytology.* — Five good text-books on this subject appeared during the year by Wilson, by Henneguy, by Fol, by Delage and Hérouard, and by Zimmermann. The idea of a diversity in protoplasmic structure, sometimes fibrillar, sometimes reticulated, sometimes vacuolated, grew, especially among those who at first opposed Bütschli's foam theory of protoplasmic structure. Nadson's discovery of nuclear matter in Cyanophyces was confirmed, with modifications, by Bütschli, who also finds it in bacteria. The chemical constitution of the nucleus received a little attention. Korschelt classified the chromatin as either basichromatin, occurring in one or more large masses, or as oxychromatin, occurring as fine granules. The known distribution of the centrosome was enlarged, its occurrence being recorded for several Protozoa, diatoms, and the ganglionic cells of vertebrates and an invertebrate (Lewis). On the other hand, Strasburger's pupils did not find it in tissue cells of phenogams. The occurrence of a centrosome in ganglionic cells, which are believed not to divide, spoke for its being a permanent cell-organ. The true relation of centrosome to attraction sphere remained to be elucidated.

Cell-division was further analyzed. The universal presence in the spindle of fibres running from one pole to the other became more generally admitted. The discussion over the origin of the spindle continued, great deviations from the type described for the salamander epithelium were made known, and the nuclear origin of the spindle was maintained for both plants and animals. Attention was especially directed, by Erlanger and

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[1] *L'Année Biologique.* Edited by Yves Delage. Vol. ii, 1896. Paris, Schleicher Frères, 1898. 8vo., 35 + 808 pp.

Henneguy, towards the accessory cell bodies ("Nebenkerne"), of which several kinds, differing in origin, were distinguished. The idea that amitosis in a cell sounds its death knell was opposed by strong cases.

Experiments to control cell-division were multiplied. The well-known hastening of cell-division by heat was observed again. Induced electric currents provoked direct division in salamander epithelium, and determined that the dividing plane should be transverse to the current (Galeotti). Norman confirmed Loeb's assertion, that in dense solutions cytoplasmic cleavage might be inhibited without interfering with nuclear division. Boveri showed that in a cleavage sphere containing archoplasm, but no chromatin, division of the archoplasm might continue in the absence of chromatin. The independence of nucleus and cytoplasm grew more evident.

*The Sexual Products and Fecundation.*—Chromatin reduction was observed in Heliozoa (Schaudinn) and Coccidiidæ (Labbé)—thus among the simplest organisms. The history of the origin of the sex-cells and their periods of multiplication and of rest were traced by Eigenmann in a viviparous fish. The question of the locus of the centrosome in the spermatozoon was undergoing debate. As for *fecundation*, the belief that the archoplasm of the female plays no part in egg-cleavage was unanimously confirmed by the several workers upon this subject.

*Parthenogenesis.* — The observation of last year on the absence of true parthenogenesis in the unfertilized eggs of the higher vertebrates was confirmed. Parthenogenesis in the lower algæ was induced artificially. It was stated (Zur Strassen) that two eggs of Ascaris may fuse, giving rise to a zygote capable of developing into a giant embryo.

*Asexual Reproduction.* — New cases of reproduction by autotomy were described for a holothurian and a nemertean. Attention was again called (by Seeliger) to the non-parallelism between budding and egg-ontogeny, and Ritter insisted on the origin of buds in Tunicates from embryonic tissue.

*Ontogenesis.* — The truth that in development preformation and epigenesis are blended, which was dawning in 1895, became still clearer as a result of the work of 1896. Especially was this due to the results of Crampton, who showed that in the gastropod Ilyanassa, when the mesodermal pole cells are removed, no mesodermal structures are produced in the embryo. Thus there is here, at a certain late cleavage stage, a specialization of cells in the germ. The series of specialization, which finds its lower extreme in the medusa and its higher extreme in the gastropod, is, however, not shown to be one of specialization of nuclear material, but rather of cytoplasmic material only. In so far as the cytoplasm of the germ is specialized, in so far is there preformation in the germ. In so far, on the other hand, as the fate of a portion of the germ is determined by its position in the body, development is epigenetic. The variation in the degree of preformation is due to the fact that the cytoplasm of some eggs exhibits little responsiveness, that of others a great deal. New evidence for the unspecialized character of the nuclei was given by Wilson, who found that potential micromeres of Nereis, forced to become macromeres, had the fate of macromeres. Last year it was shown that one-fiftieth of an echinoid egg might develop ; this year Lillie showed that one-twenty-seventh of a Stentor is capable of forming a new individual. Jennings showed that the axis of the spindle in a developing rotifer egg is not always placed in the greatest extent of the cytoplasm (Hertwig's law), but occupies various positions. The spindle is sometimes stimulated by the form of the cell to lie in its long axis, at other times to lie in its short axis, and at still other times to lie obliquely. Among attempts at a mechanical explanation of ontogenesis were those of Roux, who showed that the lines of contact of oil drops resemble those of cleavage spheres. The theory of development as a response to stimuli was enriched by the experiment of Driesch, which showed that the mesenchymatous cells of echinoid gastrulas, disarranged by shaking, return to their respective places. Self-regulation was illustrated by the observations that variations in the embryo are greater than in the adult (whence they must gradually become obliterated during development), that with shortened range of contraction of a muscle its tendinous part is increased at expense of its contractile part, and that a bone called upon to carry an abnormally great weight increases in diameter. Of these self-regulations Driesch distinguished two categories — primary, involving only normal ontogenetic processes, and secondary, involving ontogenetic processes of a new and special sort.

*Teratology.* — The most important work of the year in comparative teratology was that of Patten on abnormalities in the development of Limulus. In attempting to produce monstrosities by physical agents, Bataillon made the axis of the embryo frog lie perpendicular to that of the first cleavage plane (hence perpendicular to its normal position) by pressure, Rossi found that electricity has less effect the older the embryo, the fact that the different chemical solutions have specific effects on echinoid ontogeny was determined for echinoids by Herbst and for Amphibia by Gurwitsch, Samassa ascertained that pure oxygen has little effect on the development of the frog, and Féré found that the venom of the viper provokes anomalies in the development of the chick. De Vries showed that a highly nutritive culture-medium tends to accentuate the monstrous characters of individuals of a race of plants which is tending to revert to the normal type. Several unusual and well-worked-out cases of abnormalities in invertebrates were described by morphologists.

*Regeneration.* — While the multiplication of cases of regeneration continued as in former years, the principal lines of advance in 1896 were first in the clearer recognition of the fact that in regeneration an organ often arises from dissimilar germ-layers and develops in a different manner than it does in egg development ; and, secondly, that regeneration is often accompanied by heteromorphosis. In the first category we have Wolff's case of regeneration of the lens from the mesoderm of the iris of Amphibia, this year abundantly confirmed. According to both Michel and Hepke, the ectoderm of the earthworm gives rise to all the regenerating tissues. In the second category of cases we place the observations that regenerating eyes of shrimps may produce antenniform organs, that the regenerating antennæ of the lobster have a spiral form, that planarians, whose margins have been incised, may form multiple heads, and that the regenerated tails of lizards are of simpler organization than the normal ones. In the case of Crustacea the normal form of the organ may reappear after several molts (Przibram). A very extended study on regenerations in earthworms was made by Heschler.

*Grafting.* — This year afforded the marvelously successful results of Joest in grafting earthworms, not only one part of the worm being united to another part, but one individual to another.

*Sex and Secondary Sexual Characters.* — New experiments on sex control confirmed, on the whole, the idea that femaleness results from rich nutrition. Marchal showed that neuter wasps, when through the death or sterility of the queen there are no young in the nests, feed on the larval food and become fertile females.

*Polymorphism, Metamorphosis, and Alternation of Generations.* —Some advance was made this year in answering the question, Is polymorphism blastogenic or somatogenic? What rôle do the intrinsic conditions of the individual play, and what environment? No doubt there must be a substratum capable of responding in two or more ways, but which response shall be called into action, and how far it shall go, these are determined by extrinsic factors. The theory that a double habit (*e.g.*, the habit of a gall insect in stinging two kinds of trees) may lead to polymorphism was advanced by Beijerinck.

*Correlation.* — The most important contribution of the year was that which Pearson made to the mathematical study of the subject. Several authors contributed exact data on correlation in various species. Many special cases of correlation were described.

*General Morphology and Physiology.* — The discussion over the significance of the cell as a unit in the body was continued in France by Delage and Le Dantec. The idea that metameres are, phylogenetically, secondary divisions of the trunk gained ground.

One of the most important works of the year in general physiology was that of Loew, on the *Energy of Living Protoplasm,* in which the chemical explanation dominated. Progress was made towards a clearer understanding of the way in which sunlight is transformed into the specific, assimulative energy by chlorophyll. Tschirsch showed that chlorophyll and hæmoglobin probably originate in the same fundamental substance. The question of the process of albumen formation in plants was a burning one. Internal secretions attracted ever-increasing attention. Our knowledge of the rôle and physics of osmosis in organisms and the action on organisms of light, electricity, (Loeb, Verworn), and chemical substances received important additions, as did also phygocytosis and the action of ferments.

*Heredity.*—The year revealed an increased tendency towards experimentation. Boveri's evidence for a hybrid without maternal characters was almost annulled by the opposing investigations of Seeliger. In the matter of inheritance of acquired characters new experiments by Charrin and Gley indicated the inheritance of immunity. Loeb, testing the hypothesis that the nervous system acts as an intermediary between soma and germ cells, finds that the amphibian larva develops normally even after the axial nervous system has been severed. Very noteworthy is the fact that Ewart repeated Lord Morton's experiment in telegony with somewhat confirmatory results.

*Variation.*—The quantitative study of this subject has made good progress. Pearson investigated the mathematical laws of regression, heredity, and panmixia. Ludwig, Amann, Warren, and Thompson applied the quantitative methods to the variation of various species. Agassiz and Woodworth found the variations in a medusa — Eucope — only such as are normal in other species. The great variation in embryonic as compared with adult stages was gaining more general recognition.

*Origin of Species.* — The principal papers of the year were speculative. Weismann added to his system the conception of a struggle in the germ plasm by which those determinants which gain a slight advantage over their fellows soon get the upper hand. The theory of mimicry was strongly attacked (*e.g.*, by Piepers, after many years of observations in the Malays). The struggle around the theories of natural selection and the utility of specific characters continued. Many cases of considerable variations due to environment, forming probable starting points of species, were described.

*The Nervous System and Mental Functions.* — Great activity was displayed in the study of the structure of the nerve cell, yet the significance of the chromophile substance and the fundamental substance remained in dispute, Ramon y Cajal regarding the former as a nutritive reserve. The variations of the nerve cell in different states of function and health were the subject of much attention. The results of the immense activity in the fields of sensations, instincts, and emotions cannot be summarized.

*General Theories.* — The most important theoretical work of the year was probably Cope's *Factors of Organic Evolution.* Important also were Weismann's *Ueber Germinal Selection* and Le Dantec's *Théorie nouvelle de la vie.*

Of the subjects considered in *L'Année Biologique* five seem developing with magnificent rapidity — cytology, experimental morphology, general physiology, variation, and the nervous system. Already there are indications of the not far distant blending of the results of the work in all of these lines of investigation.